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मानक

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Mazdoor Kisan Shakti Sangathan

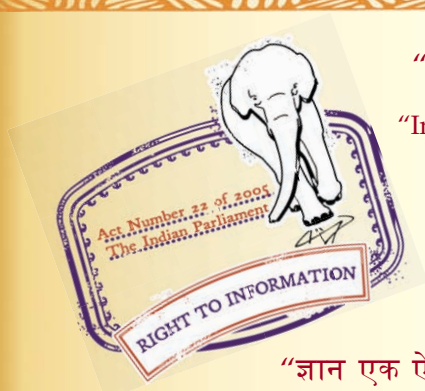
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“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 14194-1 (1994): Radionuclides in environmental samples -
Method of estimation, Part 1: Gross beta activity
measurement [CHD 30: Nuclear Materials]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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भारतीय मानक

पर्यावरण नमूनों में रेडियोन्यूक्लाइड्स —
आँकलन की पद्धतियाँ

भाग 1 कुल बीटा सक्रियता मापन

Indian Standard

**RADIONUCLIDES IN ENVIRONMENTAL
SAMPLES — METHODS OF ESTIMATION**

PART 1 GROSS BETA ACTIVITY MEASUREMENT

UDC 614.876 : 539.165

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Nuclear Materials Sectional Committee had been approved by the Chemical Division Council.

Measurement of gross beta activity is often used as a substitute for determination of individual radionuclides, because it is simple and rapid. But the data is of no use for interpretation. The gross beta activity is of use only for comparison purposes and does not fulfil the purpose of individual radionuclide analysis. In this method, the total beta activity of prepared samples are counted by Geiger Muller (GM) counting system. Keeping in view this fact the Committee decided to formulate this standard.

The calibration of GM counter for measuring the total beta activity of mixed fission products is a difficult problem. The effective energy of the fission products changes with time and most samples have considerable mass so that self-absorption becomes an important factor. Normal practice is to use the radiation from natural potassium as a standard for the beta activity of mixed fission products.

Composition of the committee responsible for formulation of this standard is given at Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

RADIONUCLIDES IN ENVIRONMENTAL SAMPLES — METHODS OF ESTIMATION

PART 1 GROSS BETA ACTIVITY MEASUREMENT

1 SCOPE

This standard prescribes the method of measurement of gross beta activity applied to water, waste water, soil, smears, gummed paper, air filters, ash of vegetation and biological samples and other materials to estimate contamination from industrial exposure, fallout and natural background.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

<i>IS No.</i>	<i>Title</i>
264 : 1976	Nitric acid (<i>second revision</i>)
265 : 1993	Hydrochloric acid (<i>fourth revision</i>)
1070 : 1992	Water for general laboratory use (<i>third revision</i>)

3 TERMINOLOGY

3.1 For the purpose of this standard the following terms shall apply.

3.1.1 Activity

The number of spontaneous nuclear disintegrations occurring in a given quantity of material during a suitably small interval of time divided by that interval of time. It is commonly expressed in Becquerel (Bq), formerly expressed in Curies.

NOTE — Sometimes used to designate a quantity of radionuclide (also called disintegration rate).

3.1.2 Nuclide

A species of atom characterized by its mass number, atomic number and nuclear energy state, provided that the mean life in that state is long enough to be observable.

3.1.3 Radionuclide — A radioactive nuclide.

4 PRINCIPLE

For measurement of beta activity of water, waste water, soil, gummed paper, air filters and ash of vegetation and biological samples, the samples taken are prepared with suitable treatment and then measured for beta activity by a Geiger Muller counting system.

5 EQUIPMENT

5.1 Geiger Muller (GM) Counting System

The background counts should normally be about 0.15 Bq with about 10 percent efficiency for K-40 beats.

5.2 End-Window GM Detector — with 508 mm lead shield.

5.3 Sample Holder Assembly — capable of taking 25 mm diameter aluminium planchets with 2 to 3 mm rims.

5.4 Aluminium Planchet — 25 mm diameter and with 2 to 3 mm rims.

5.5 Air Oven

5.6 Infra Red Lamp — of 500 W.

5.7 Muffle Furnace

5.8 The background counts should be normally about 0.15 Bq with about 10 percent efficiency for potassium (K-40) beats.

6 PREPARATION OF SAMPLE

For the gross activity estimation, preparation of sample should be simple and fast. The methods of sampling prescribed in 6.1, 6.2, 6.3, 6.4 and 6.5 are usually followed for the environmental samples to be tested for radioactivity of water, soil, vegetation, biological samples, air filters, gummed paper or filter paper swipe samples.

All the samples collected, shall be properly labelled, giving the following details:

- a) Sample No.,
- b) Description of samples,
- c) Location of sample collection, and
- d) Date of collection.

6.1 Water

6.1.1 Collect the water sample in a polythene bottle after rinsing with same water. 100 ml sample should be sufficient for gross activity determination.

6.1.2 Transfer 1 ml of water to the aluminium planchet kept under infra red lamp. Put on the lamp and evaporate to dryness. Repeat this process another four times, so that total volume of sample is evaporated to 5 ml.

6.1.3 Cool the completely dried sample planchet. Add 2 drops of 1 percent collodion in acetone. Allow the acetone to evaporate. This sample should be counted in the beta counter.

6.2 Water with High Dissolved Solids

6.2.1 Take 500 ml or 1 000 ml of water sample. Add 5 ml concentrated hydrochloric acid, stir and then add 5 mg ferric chloride or ferric nitrate as iron carrier. Warm on a hot plate and add 8 N ammonia with stirring to adjust the pH at 7, when ferric hydroxide precipitates. Allow the precipitate to settle.

6.2.2 Separate ferric hydroxide by decanting and centrifuging. Wash the precipitate with 10 ml distilled water twice and discard washings.

6.2.3 Slurry the ferric hydroxide precipitate with 1 ml distilled water and transfer to a 25 mm aluminium planchet using a glass dropper with attached rubber teat. Dry the slurry under an infra red lamp, transfer the precipitate completely using further small amount of distilled water.

6.2.4 Dry the planchet under infra red lamp. Ferric hydroxide when dried, flakes off. (Use a pointed glass rod to spread the sample uniformly in the planchet) after cooling the planchet, add a drop or two of 1 percent collodion in acetone, dry and the planchet is ready for counting.

6.3 Soil

6.3.1 Take the surface soil (up to a depth of 5 cm) from the required location. Sample can be taken from a known area using a square or rectangular frame of known area, when activity has to be expressed as Bq/m². Remove pebbles and grass root in that portion, dry the sample in an oven at 110°C. Powder the soil using a mortar and pestle.

6.3.2 Take 25 mg of dry soil powder in a 25 mm dia aluminium planchet. Spread evenly, add a few drops of collodion solution to fix it to the planchet and then count in beta counter.

6.4 Vegetation/Soft Tissues of Biological Samples

6.4.1 Take known weight (100 g) of the sample, dry it in oven at 110°C. Take the dry weight and powder the dry material in a grinder.

6.4.2 Take 25 mg of the powdered sample in the aluminium planchet and fix it with a few drops of collodion solution. Count the sample in a beta counter.

6.4.3 If the sample does not give any detectable count, ash known weight of dried sample in a muffle furnace at 450°C.

6.4.4 Take the ash weight and grind the ash to fine powder.

6.4.5 Mount 25 mg of ash powder on an aluminium planchet and count in a beta counter after fixing it with a few drops of 1 percent collodion solution.

6.5 Air Filters or Gummed Paper Deposits or Filter Paper Swipes

6.5.1 If the sampling is done on a filter paper disc fixed on 25 mm air sampling head, it can be mounted directly to an aluminium planchet and count for beta activity.

6.5.2 If the sampling filter disc is of bigger diameter or rectangular of known area as in the case of high volume samplers, cut 24 mm diameter discs from the sample and mount on an aluminium planchet and count for beta activity.

6.5.3 In the case of air sampling the set up should have a flowmeter and a time totaliser to estimate the volume of air filtered.

NOTE — Record the flow rate at beginning and ending of the sample and take the average of these two for calculating the volume of air sampled.

6.5.4 In case of swipe sample, note the area over which the swipe sample taken. Swipe samples are taken to estimate loose contamination on any surface.

6.5.5 In case gummed paper deposition collection for evaluating the dry fallout deposition, the area of collection paper should be known for evaluating Bq/m² or Bq/km² deposition.

7 CALIBRATION

7.1 For calibration of G M counter the normal practice is to use the radiation from natural potassium as a standard for the beta activity of mixed fission products. The average energy of Potassium-40 is 0.40 MeV. This is the best approximation of the energy for mixed fission products among the available long-lived isotopes.

NOTE — The potassium activity is taken from the Nuclear Data Sheets of the National Academy of Sciences. The values are 28 betas per second per gram of potassium, and 3.5 gamma photons per second per gram of potassium.

7.2 The mass of the actual samples can usually be approximated quite well by a suitable mass of potassium chloride. In some cases where a more active standard is desired, pressed pellets are made up with several grams of potassium chloride (with a few percent of sodium stearate). These counter standards are first calibrated against the proper weight of potassium chloride and then are used merely to check reproducibility of the counters.

8 ACTIVITY MEASUREMENTS

8.1 Keep the GM counting system on for at least an hour to stabilise in case the counter is not already 'on'.

8.2 Take 1 000 second background counts with a blank aluminium planchet.

8.3 Keep the sample planchet in the counting system and count for 1 000 second.

8.4 Determine the efficiency of the counter using a standard Potassium-40 source.

9 CALCULATION

9.1 Evaluate the size of the sample taken for the measurement in ml for water sample, gram for soil, vegetation and biological tissues, m^3 in case of air filter and m^2 in case of gummed paper or swipe filter paper sample.

Count rate of the sample in count per second (cps) in

the planchet (R) = $\frac{N}{1\ 000} - \frac{B}{1\ 000}$

where

B = background counts for 1 000 second with a blank aluminium planchet; and

N = count of sample for 1 000 second.

Activity of the sample collected in Bq/unit sample

$$(A) = R \times \frac{100}{E} \times \frac{1}{S}$$

where

E = efficiency of the counter using a standard Potassium-40 source, in percent; and

S = the size of the sample taken for counting. Normally expressed in g or ml except in case of air filter sample where it is expressed in m^3 and in case of fallout deposition sample where it is expressed in m^2 .

ANNEX A

(Foreword)

COMMITTEE COMPOSITION

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Uranium Corporation of India, Jaduguda

Bhabha Atomic Research Centre (Radiometallurgy Division), Bombay
Ministry of Defence (R & D), New Delhi

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Institute of Nuclear Medicine and Allied Sciences, Delhi

Madras Atomic Power Station, Madras

Atomic Energy Regulatory Board, Bombay
Ministry of Defence (DGQA), New Delhi

Ministry of Environment and Forests, New Delhi

Tata Institute of Fundamental Research, Bombay

Steel Authority of India Ltd (R & D Unit), Ranchi

Board of Radiation and Isotopes Technology, Bombay
National Fuel Complex, Hyderabad

Nuclear Power Corporation, Bombay

Bhabha Atomic Research Centre, Fuel Chemistry Division, Bombay
Bhabha Atomic Research Centre, Radiation Protection Division, Bombay
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Joint Director (Chemical), BIS

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Bhabha Atomic Research Centre, Health Physics Division, Bombay
Central Pollution Control Board, New Delhi

Nuclear Power Corporation Bombay

Bhabha Atomic Research Centre, Radiation Protection Division, Bombay
Ministry of Defence (DEBEL), Bangalore
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This Indian Standard has been developed from Doc No. CHD 030 (0614)

Amendments Issued Since Publication

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